MPA MaterialsMatter

August 2011

INSIDE

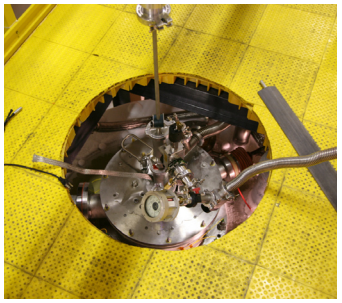
NHMFL-PPF and LANL retake pulsed magnetic field lead in quest for 100T

By Karen E. Kippen
ADEPS Communications

The control room in anticipation of the Friday shot. (Photos by Robb Kramer, ADEPS Communications.)

Crammed into the tight confines of the Magnet Lab's control room, they gathered, lab notebooks or caffeine of choice in hand. Their conversation reflected a giddy sense of anticipation tempered with nervousness.

Here, on the afternoon of August 18, condensed matter scientists, high-field magnet technicians, technologists, and pulsed magnet engineers came together to witness the National High Magnetic Field Laboratory's Pulsed Field Facility (NHMFL-PFF) at Los Alamos National Laboratory retake the world record for the strongest magnetic field produced by a non-destructive magnet.



The 100 T Multi-shot Magnet from the perspective of the users.

With Mike Gordon commanding the controls that draws power off of the massive 1.4 gigawatt generator system and directs it to the magnet, all eyes and ears were keyed to the video monitors showing the massive 100 Tesla Multi-shot Magnet and the capacitor bank located in the now eerily empty Large Magnet Hall next door.

At 92.5 Tesla, NHMFL researchers won back the world record for the strongest magnetic field produced by a non-destructive magnet.

The next day, the team surpassed that achievement with an outstanding 97.4 Tesla field.

Then came the low warping hum followed by a spine-tingling metallic screech signaling the magnet spiking with electric current as more than 100 megajoules of energy are precisely distributed to the complex electro-magnet. As the sound dissipated and the monitors showed the magnet performed perfectly, attention turned to the acquired data, and then proof positive through two in situ measurements that the 100 Tesla Multi-shot Magnet had achieved 92.5 Tesla, thus yanking back from a team of German scientists, a record Los Alamos had held for five years.

It was to be an achievement the NHMFL-PFF team beat handily the next day, when they set an even newer world record with an outstanding 97.4 Tesla.

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From Toni's Desk

We are in the midst of a turbulent summer, after returning from an evacuation of Los Alamos due to a wildfire threatening our Laboratory and town and destroying homes, forests, and wildlife in our surrounding mountains. We are truly fortunate that damage at the Laboratory and in Los Alamos was minimal. Our fortune is due in great part to those emergency personnel—firefighters, police, communication workers, support personnel, Laboratory and community leaders—who worked around the clock to keep our town and Lab intact. I must add that I am impressed at how well our new Director led the Laboratory through the fire and its aftermath. On behalf of all of us in MPA Division, I offer these folks our sincere thanks. I would also like to offer condolences to our fellow workers and neighbors whose homes were destroyed.

Finally, I would like to add that this has been a very stressful time for all of us, particularly for those newly-arrived students and postdocs who live in Los Alamos without the support of their families. If you or one of your colleagues are feeling stressed out or overwhelmed by the events of the summer, please take the time to recover your equilibrium.

Upon return from the evacuation, MPA Division leadership spent a day walking down our space to identify potential hazards prior to this restart of operations and we found no significant issues or impacts from the fire. The following day, when the Laboratory opened, we began the process of walking down and conducting pre-job briefs for our moderate and high-hazard operations as prerequisite to restart activities, in order to be confident that our safety envelope had been maintained following the fire.

All said, I am quite pleased at how quickly and efficiently MPA personnel got our labs up and running, as most essential activities were restarted within a week.

'Hosting students is critical to maintaining and enhancing the intellectual vitality of our scientific staff ...'

A high point of this summer has been interacting with the many students working in MPA and around the Laboratory. Hosting students is critical to maintaining and enhancing the intellectual vitality of our scientific staff because they bring fresh perspectives and approaches to tackling the technical challenges we face, along with questions that may compel us to critically reevaluate our assumptions or conclusions. Further, our students provide windows to the outside scientific community that are essential for MPA's numerous outreach activities. So, although it is a bit late to do so, I would like to personally welcome our new and returning students.

As a token of appreciation for our students, MPA and MST Divisions, along with the LANL Institutes, sponsor a Summer Lecture Series during June and July, which provides talks from scientists around the Lab, as well as tours of the Lujan Neutron Scattering Center, the National High Magnetic Field Lab and the Center for Integrated Nanotechnologies. This summer's 21 talks ranged from Terry Wallace's "Earthquakes," to Nobel Laureate Dudley Hershbach's "Barriers to Barrierless Reactions: Expect the Unexpected," to MPA's Jennifer Hollingsworth's "A Bright Future for Solid State Lighting and Quantum Dots." The series concluded with an ice cream social in the MSL courtyard, where I recently had the privilege of serving more than 300 students and hearing about their experiences.

Finally, our MPA picnic was a great success and a huge morale booster following the fire. Thanks to our great organizing committee, led by Susie Duran, to the MPA group leaders for their superior culinary skills, and to Dylan Conradson and his band for providing excellent entertainment.

MPA Division Leader Toni Taylor

World record . . . This record puts them that much closer to delivering a magnet capable of achieving 100 Tesla, a long sought after goal by researchers from around the world including scientists in competing magnet labs in Germany, China, France, and Japan.

For perspective, a junk-yard magnet comes in at 1 Tesla, an MRI scan 3 Tesla, and the Earth's magnetic field 0.0004 Tesla. While other magnets can produce much higher fields, they are destroyed in the process-essentially one-shot science experiments.

With this achievement, the Pulsed Field Facility at LANL, a national user facility, with campuses at Florida State and the University of Florida, will provide user pulses at 95 Tesla on a routine basis, enticing the worldwide user community to Los Alamos for a chance to use this one-of-a-kind capability. High magnetic fields are an essential tool for researchers studying fundamental properties of materials, from metals and superconductors to semiconductors and insulators as the electrons in the materials are directly influenced by the magnetic fields.

Such a powerful non-destructive magnet could have a profound impact on a wide range of scientific investigations, from how to design and control material functionality to research into the microscopic behavior of phase transitions. This type of magnet allows researchers to carefully tune material parameters while perfectly reproducing the non-invasive magnetic field. Such high magnetic fields confine the electrons to nanometer scale orbits, which reveal the fundamental quantum nature of the material.

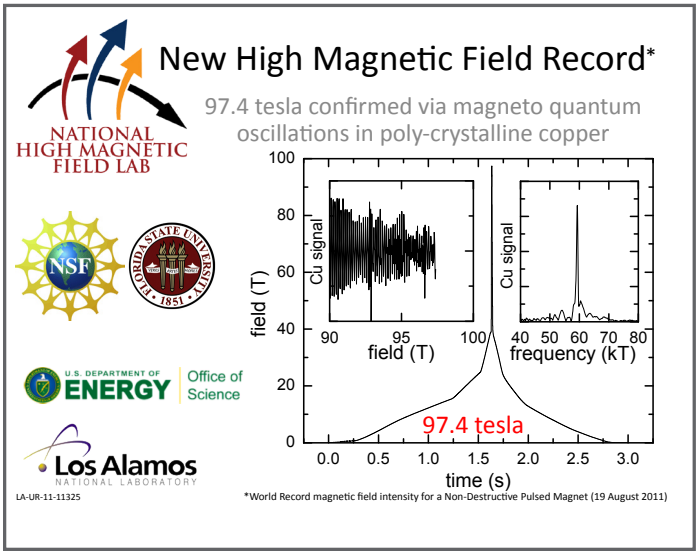
The NHMFL is sponsored primarily by the National Science Foundation, Division of Materials Research, with additional support from the State of Florida and the DOE. These recent successes were enabled by long-term support from the U.S. Department of Energy's Office of Basic Energy Sciences, and the National Science Foundation's 100 Tesla Multi-shot Magnet program.

MPA scientists win two R&D 100 Awards

MPA scientists have won 2 of *R&D Magazine*'s 2011 R&D 100 Awards. These awards honor the top 100 proven technological advances of the past year.

The winning MPA projects are NanoCluster Beacons created by Hsin-Chih (Tim) Yeh, James Werner, Jaswinder Sharma, and Jennifer Martinez (Center for Integrated Nanotechnologies,

Above: Mike Gordon (right) preps for the Friday shot, as Yates Coulter of the Superconductivity Center gathers data for his experiment within the 100 Tesla Mult-shot Magnet. Below: The results!



MPA-CINT) and Th-ING (Thorium Is Now Green), developed by Jaqueline Kiplinger (Materials Chemistry, MPA-MC) and Thibault Cantat (formerly of Condensed Matter and Magnet Science, MPA-CMMS). Also receiving an R&D 100 Award was TAPSS, (Trapped Annular Pressure Shrinking Spacer), by Robert Hermes (Technology Transfer, TT-DO), in collaboration with Chevron Energy Technology Company, Baker Hughes Incorporated's Drilling Fluids Unit, and Lucite International Ltd.

An additional MPA project, Reactive Co-Evaporation by Cyclic Deposition and Reaction (RCE-CDR), also was submitted for consideration.

NanoCluster Beacons are collections of silver atoms maneuvered to illuminate when bound to specific nucleic acids, such as the DNA of

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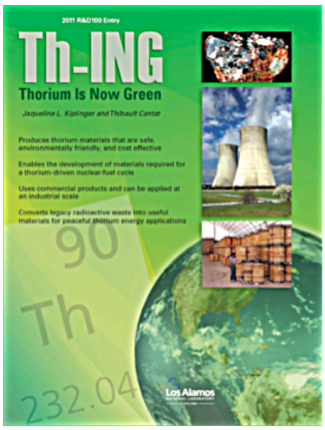
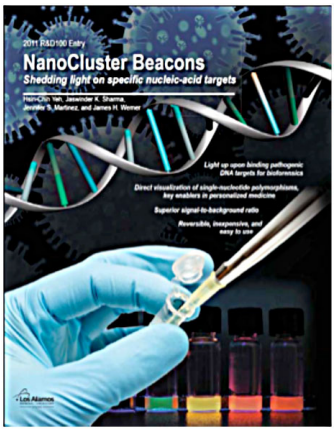
R&D 100 . . . particular pathogens. These beacons can be used to probe for diseases that threaten humans by identifying the nucleic acid targets that represent a person's full genome, and allow for personalized medication. They also can be used in quantitative biology applications, such as counting individual molecules inside a cell. The LANL Laboratory Research and Development (LDRD) program funded the work.

Once bound with a specific target, a NanoCluster Beacon lights up, emitting fluorescence approximately 200 times greater than in the unbound state and easily viewed by the naked eye under ultraviolet light. The beacons come in an array of colors for multiplexed analyses, are more photostable than beacons used today, and can be turned on and off reversibly. Inexpensive, easy to use, and reversible, NanoCluster Beacons are superior molecular probes for detecting specific targets, human oncogene (cancer) sequences, and molecular disease sequences (such as sickle cell anemia).





Th-ING is a straightforward, cost-effective, and safe method to produce thorium. Thorium is an element discovered in 1828 that is capable of producing more energy than both uranium and coal using significantly lower quantities. This element is only slightly radioactive, making it an excellent candidate for a future sustainable energy source. It is so safe that it will never lead to a nuclear meltdown when used in a nuclear reactor.

Before Th-ING, thorium could only be produced in hazardous settings at unreasonably high prices. This new method involves reacting thorium nitrate with aqueous hydrochloric acid under mild conditions, which can be performed using conventional glassware in a traditional laboratory setting. Then, a novel combination of anhydrous hydrochloric acid and trimethylsilyl chloride is used to remove coordinated water molecules, replacing them with dimethoxyethane to make the new thorium chloride reagent. The process cuts costs of production from $5,000 per kilogram to a mere $30 per kilogram and is "green"—as it does not produce wasteful solvent ring-opening/polymerization or waste thorium (95 percent production yields). With Th-ING, thorium becomes a practical and reliable source of energy for the future.

The work was funded by the Department of Energy, Basic Energy Sciences, Heavy Element Chemistry Program and LANL LDRD program. Also, Cantat was a Director's Funded PD Fellow.

Superconductor wires can enhance the performance of a variety of devices including generators, transmission cables, and superconducting magnets, such as those used in MRI devices, by offering zero loss in electric power applications. However, they are not broadly accepted due to their high production cost. RCE-CDR was developed by Vladimir Matias, Chris Sheehan (Superconductivity Technology Center, MPA-STC), Jonathan Storer, Jens Hänisch (formerly MPA-STC), and J. Yates Coulter (MPA-STC) in collaboration with Superconductor Technologies, Inc. to fabricate lower-cost, higher-performance superconductor wires and make them more practical to produce in the commercial market.

RCE-CDR uses a unique reel-to-reel deposition process, feeding tape wound on a number of reels through a rotary heater, which continuously rotates the tape between a pulse of elements deposited on one side of the heater to an oxygen pressure on the other side, which causes the elements to react and form the superconducting coating compound on the tape. The reels move sections of tape at a time through the rotary heater, and each of the sections in the heater is rotated through the pulsed deposition of elements and the reaction zone until a desired thickness of coating has been achieved. The section of tape is then moved onto the take-up reels and slit lengthwise into wire. Compared to current manufacturing methods, RCE-CDR achieves higher throughput, produces thick coatings capable of carrying higher currents in a magnetic field, and is up to 20 times less expensive. Ultimately, this process lowers production costs of superconductor wires and opens the door for broad commercial acceptance.

Funding for the work was provided by DOE- Office of Electricity Delivery & Energy Reliability.

Thermal tunability in terahertz metamaterial achieved on strontium titanate single crystals

Although split-ring resonator (SRR) based metamaterials are attractive for use in devices with novel functionalities over a large electromagnetic spectral domain, devices incorporating SRRs fall short on the performance due to lack of dynamic control over their resonances. Researchers Ranjan Singh, Hou-Tong Chen,

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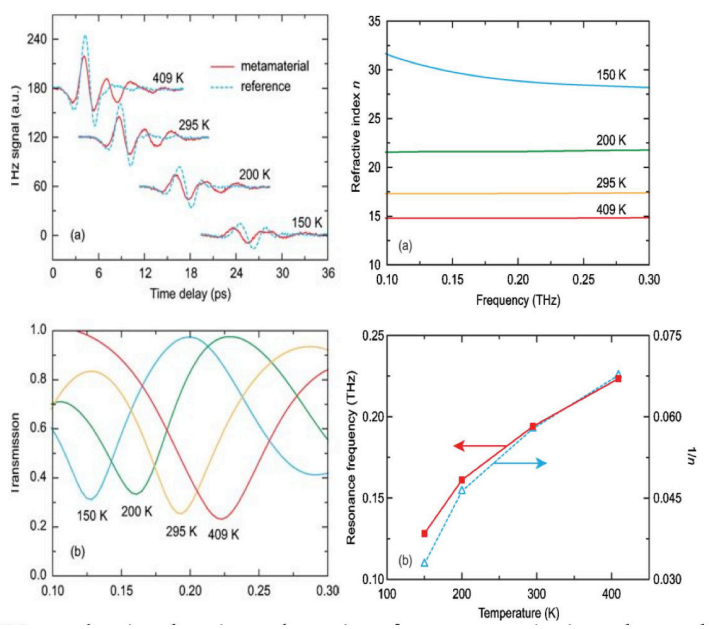

At various temperatures, (a) THz pulse in the time-domain after transmission through the metamaterial and a bare STO substrate, (b) normalized THz transmission amplitude spectra through the metamaterial, (c) refractive index of the STO substrate as a function of THz frequency, and (d) a comparison of resonance frequency and inverse of STO refractive index. Inset to (a) is the microscopy image of a metamaterial unit cell.

Thermal . . . Abul Azad, Quanxi Jia (MPA-CINT) and Toni Taylor (Materials Physics and Applications, MPA-DO), hypothesize that in most cases the frequency tuning of metamaterial resonance is accompanied with a large variation of resonance strength, which is undesirable and caused by the damping from the materials integrated in metamaterials.

To test this idea, the researchers fabricated a planar square array of subwavelength 200-nm-thick gold electric SRRs on a 533-μm-thick single crystal (100) oriented strontium titanate (STO) substrate. They measured the resonant behavior in the THz frequency range of the metamaterial as a function of temperature using a time-domain spectroscopy (TDS) system incorporated with a continuous flow liquid helium cryostat. Based on this experiment, the researchers observed a 43% shift in resonance frequency after cooling the metamaterial from 409K to 150K with less disparity in resonance strength. They attributed this behavior to the temperature dependant dielectric constant of strontium titanate.

The experiment opens up avenues for designing tunable terahertz devices by exploiting the temperature-sensitive characteristic of high dielectric constant substrates and complex metal oxide materials. Such a thermal tuning of metamaterial resonance using STO and ferroelectric materials will enable the integration of metamaterials with other complex metal oxides and resonance tuning approaches to realize multifunctional THz metamaterial devices.

The Los Alamos Laboratory Directed Research and Development program supported the work. It was performed, in part, at the Center for Integrated Nanotechnologies, a U.S. Department of Energy, Office of Basic Energy Sciences Nanoscale Science Research Center operated jointly by Los Alamos and Sandia National Laboratories. The work supports the Global Security mission area and the Materials for the Future science pillar.

Reference: "Thermal Tunability in Terahertz Metamaterials Fabricated on Strontium Titanate Single-crystal Substrates," *Optics Letters* **36**, 1230 (2011).

Technical contact: Hou-Tong Chen

$CeIrIn_5$ research captures attention in global scientific journal

What's so sensational about superconductor $CeIrIn_5$, a member of a family of heavy-fermion compounds discovered at Los Alamos?

The groundbreaking work has been cited 315 times in a global scientific journal since Los Alamos and Florida State University researchers wrote a discovery paper about $CeIrIn_5$ in 2001. When *Europhysics Letters*, a peer-reviewed journal published by the European Physical Society, celebrated its 25th anniversary, it published a collection of the 40 most cited papers since the journal's inception – and $CeIrIn_5$ made the list.

Most Cited Articles From 1986 – 2011 is free to read at www.epljournal.org through Dec. 31. Participating Los Alamos researchers from MPA-CMMS were Cedomir Petrovic, Roman Movshovich, Marcelo Jaime, Pascoal G. Pagliuso, Michael Hundley, Zachary Fisk, and Joe Thompson. John Sarrao (SPO-SC, Science Program Office, Office of Science) also contributed to the paper.

In $CeIrIn_5$, very heavy electrons pair up at low temperatures to create an unusual form of superconductivity. The layered crystal structure and other properties of $CeIrIn_5$ suggested a possible analogy to the cuprate superconductors whose much lighter electrons also become superconducting, but at temperatures nearly 300 times higher than in $CeIrIn_5$.

If this analogy were proved correct, it would imply that the physics responsible for superconductivity is extremely robust and independent of special characteristics of the cuprates, Thompson noted. Continued research at Los Alamos and elsewhere has provided support for this analogy and demonstrated that some of the special characteristics of the cuprates may be present in $CeIrIn_5$, he said.

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Journal... One of the most fascinating questions raised by unconventional superconductivity in the cuprates is whether the superconductivity is related to a peculiar state of the electrons, called a pseudogap, which appears at temperatures well above the onset of super-conductivity. Scientists hotly debate this question, but recent experiments at Los Alamos reveal the possibility of a similarly exotic state of heavy electrons in $CeIrIn_5$.

"Time will tell if the analogy holds in detail," Thompson said, "and this is one of many reasons why $CeIrIn_5$ continues to fascinate the imagination of scientists around the world."

Of the vast number of metallic compounds, only a small fraction enters a superconducting state at low temperatures, and of this small number, an even smaller fraction develops superconductivity out of a normal state in which electronic correlations produce orders-of magnitude enhancement of the conduction electrons' effective mass.

This subset of materials, known as heavy-fermion superconductors, has been an influential area of research in condensed-matter physics since its first member, $CeCu_2Si_2$, was discovered in 1979.

The U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Science and Engineering sponsored the $CeIrIn_5$ research.

Reference: "A new heavy-fermion superconductor $CeIrIn_5$: a relative of the cuprates?" *Europhysics Letters* **53** 354 (2001).

Technical contact: Joe Thompson

Los Alamos fuel cell research cited by FreedomCAR and Fuel Partnership

For the eighth year in a row, the FreedomCAR and Fuel Partnership has recognized Los Alamos fuel cell research, funded by the DOE/EERE Fuel Cell Technologies Program Office, as a top technical accomplishment.

The report, which was made public in April, summarizes key milestones achieved in support of the FreedomCAR and Fuel Partnership in 2010. This time, the LANL Fuel Cell team was cited for three significant research projects, rather than just one or two.

"The streak continues," said Sensors and Electrochemical Devices (MPA-11) Group Leader Catherine Padró.

The cost of fuel cells won't drop unless precious metals are removed from proton exchange membrane fuel cells. LANL's Fuel Cell team has found a promising solution: new non-precious metal catalysts. Researchers, led by Electrochemistry Team Lead Piotr Zelenay, are making strides with olyaniline (PANI)-Fe-C catalysts

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and cyanamide-Fe-C catalysts. But before the new catalysts can be used in fuel cell systems for cars, the stability of the materials must be proved and the performance must be enhanced.

In addition, the Fuel Cell team, led by Materials Chemistry Team Lead Fernando Garzon and Project Leader Tommy Rockward, was cited for studying the effects of impurities in both the hydrogen fuel stream and the air stream. Impurities compromise the performance and durability of fuel cells. This year, significant progress was made in understanding the primary poisoning mechanisms of ammonia contamination, as well as in developing strategies to recover from ammonia poisoning.

Finally, in collaboration with Sandia National Laboratories, LANL's Hydrogen Safety, Codes & Standards Project, led by Padró, also helped develop test requirements for hydrogen and fuel cell vehicle regulations. Development of performance-based and harmonized international codes, standards and regulations is critical to fair and open competition in worldwide markets for hydrogen and fuel cell vehicles.

Technical contact: Cathy Padró

Tour allows elementary students to feel the pull of magnet science

Marshmallows being crushed under the pressure of earth's atmosphere and a stop at a generator large enough to power all of New Mexico—these were just two of the highlights for local

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Yates Coulter (left), parent/escort Corey New and Mike Gordon (right) lead students on a tour of the mammoth generator used to power the Pulsed Field Facility.

Students peer over the table to get a closer look at their marshmallow creations undergo some drastic pressure changes. Post Doc Yan Li (left), parent/escort Russell Johns and tour leader Dwight Rickel look on with the Aspen Elementry students.

Nearly 50 third-graders participated in a day of "magnet fun" at the NHMFL-PFF, according to Chuck Mielke.

Intellectual Property:

At Los Alamos National Laboratory one of our many duties as we perform our work is to protect the intellectual property (IP) of the Laboratory. IP includes inventions, discoveries, and software. Inventions and discoveries are typically patented following the disclosure process and market potential evaluation while software is copyrighted. Inventions can include a new process or machine, an article of manufacture, a novel composition of matter, or new and useful improvements on known inventions.

To be patented the invention needs to be novel, not obvious, and have a useful purpose. For U.S. patents there can be no publication of the invention more than one year prior to the patent application. Copyright is another way to protect IP and applies to computer programs, user interfaces and films, videos or recordings related to Laboratory work. When employees accept a position with the Laboratory, they agree to report any patentable device, process, or product discovered during their Laboratory employment. The Laboratory's Technology Transfer (TT) Division helps protect IP and foster the movement of technologies from the Lab to the marketplace to benefit society and the U.S. economy. The IP generated with the help of TT has many benefits that can range from sharing of licensing income with both the inventors and the group/division to establishing LANL as a lead in programmatic technology. ADEPS has traditionally been a significant contributor to IP, from disclosures to patents to CRADAs and licensing agreements.

IP protection begins with a disclosure. In the case of software this comes about when software is planned to be sent outside the Laboratory and the worker must fill out a software release form (1736) and a copyright disclosure form (1713). TT will then do an evaluation to decide if a copyright should be pursued. This is typically a straightforward process.

For inventions and discoveries the disclosure may be initiated by the inventor or may come about as part of the review process when a Technical Information Release is signed and potential IP is identified. A disclosure is filled out through the Invention Disclosure Electronic Application System (IDEAS). IDEAS can be found at ideas.lanl.gov and is a Web-based application to help assist the inventor in filing a disclosure. The disclosure process helps both to secure the IP rights and provide TT with the information about the commercial and licensing potential of the invention. TT will then do an assessment for market potential and make a recommendation as to whether or not the technology should be patented. If the decision is to go ahead and patent, then the Laboratory's legal department will assign a patent attorney to begin working with the inventors to develop a patent. An intermediate step is often employed if there is extreme urgency to balance timely publication for programmatic activities with protecting the IP or in the case where the technology is still in the process of being reduced to practice fully. In these cases a provisional patent may be filed, which can be done rapidly and allows one year to file a full patent while protecting the invention date. This can also provide more time to develop a full patent.

The Laboratory's Technology Transfer Division helps protect IP and foster the movement of technologies from the Lab to the marketplace to benefit society and the U.S. economy.

Inventors may feel that the process is daunting or distracting to publishing papers, but this does not have to be the case. If there is urgency associated with a publication, then it should be conveyed to TT when submitting the disclosure. This can help streamline the process and a provisional patent can be finished rapidly if the IP is deemed as valuable. It is important for the inventor to interact with the patent attorney during the writing of a full patent. The legal attorney can only write good claims when the inventor has communicated the full impact of the invention. Detailed back and forth discussions can help define the entire scope of the invention. It can take some time to get a published patent. The review process at the U.S. patent office can itself take a year or more as claims may be initially rejected and viewed as obvious based on prior art. The legal attorney, through consultation with the inventor, must then respond to the arguments for rejection from the patent office. A patent attorney may ask for advice on a claim rejection a year after

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Tour... students who recently toured the NHMFL-PFF.

About 50 third grade students from Los Alamos's Aspen Elementary School participated in the Grade School Outreach Tour, which was led by MPA-CMMS staff and scientists.

"It went really well and was very rewarding," said MPA-CMMS Deputy Group Leader and Pulsed Field Facility Director Chuck Mielke. "The kids were really receptive and showed a lot of interest in the science. They asked a lot of good questions and had great insight."

The students were treated to several demonstrations using the magnet lab's equipment, including how eddy currents are produced by placing a conductor in a changing magnetic field and a hands-on demonstration of generating electrical power to light a light bulb.

"Everyone involved had a great time," said Dwight Rickel (MPA-CMMS), one of the tour leaders. "The kids enjoyed seeing all the demonstrations and we really enjoyed showing them how much fun science can be." Rickel, who guided students to the Single Turn Magnet system, which produces six million times the earth's magnetic field), said the event was a good learning experience for the students. "The kids really loved seeing videos of magnets blowing up (and) the showers of sparks from the multi-Mega-Amp shot of the single turn magnet (video recording)," he said.

Using a plastic vacuum chamber and marshmallows with painted faces, students watched as the confections expanded when the pump was turned on and then were crushed as the air pressure was returned. "It was a fun example and the kids really enjoyed seeing the marshmallows getting squished," Mielke said.

In addition to Mielke and Rickel, MPA-CMMS participants included Mike Pacheco, Scott Crooker, Jon Betts, Billy Vigil, Julie Gallegos, Layla Booshehri, Victor Fanelli, Alan Paris, Yan Li, Darrel Roybal, Mike Gordon, Yates Coulter, Moaz Altarawneh, Jason Lucero, and James Michel.

- By Francisco Ojeda, ADEPS Communications

Celebrating service

Congratulations to the following MPA employees celebrating service anniversaries this month:

Antoinette Taylor, MPA-DO	25 years
Charles Mielke, MPA-CMMS	15 years

Desk... initial filing of the patent. It is critical for the inventor as the expert in the field to help the patent attorney to secure a good final patent.

Although the patent process can be a long road, at the end there can be tremendous benefits. These come in many forms including licensing income, new partnerships with companies in the form of CRADAs, and the personal reward of seeing your research turn into an actual product. Along the way there can also be accolades such as R&D 100 awards. The R&D 100 award is an annual competitive process in which researchers at the Lab submit their recent inventions in a contest to identify the best inventions of the year. LANL won at total of three R&D awards this year including ones for Nano-Cluster Beacons and Thorium is Now Green, which were submitted from teams within ADEPS (see article on page 3).

I encourage everyone to submit a disclosure through the idea system whenever they have a novel invention and fill out the copyright disclosure form when they have written code that may need to be trademarked. If you have any issues with the patent process, feel free to bring them up to the patent advisory board representative.

—MPA-MC Group Leader T. Mark McCleskey, current patent advisory board representative for ADEPS

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Resetting a 15A or 20A, 120V electrical circuit breaker

Many of the buildings we occupy originally were designed and built for other purposes and in some locations we've reached the maximum capacity of the available power. Also, older buildings typically have single pane windows and lack good insulation leading to the use of portable space heaters in the winter and window air conditioners in the summer. As a result, it's not uncommon that you turn something on and a circuit breaker trips. Less commonly, a circuit breaker may fail due to age or wear and tear. That's the reason the facilities have a circuit breaker maintenance program. In fact, in FY10 circuit breaker inspections at LANSCE found about 20% failed, and failed and aging breakers forced work stoppages at Sigma (SM-66).

If you know which panel in your facility contains the circuit breaker that tripped, can you reset the breaker? The answer, unsurprisingly, is it depends; but first some background information.

Effective March 1, 2011 revision 1 of the Electrical Safety procedure (P101-13) became effective. This was a fairly extensive rewrite of the procedure with additional information from the National Fire Protection Association (NFPA) 70E document, "Standard for Electrical Safety in the Workplace." Translated, this means (among other things) that P101-13 addresses the arc-flash hazard, and that in turn results in requirements for personal protective equipment (PPE) when resetting a circuit breaker. The minimal PPE for resetting either a 15 amp or 20 amp circuit breaker is a cotton lab coat with long sleeves, long pants made of non-melting or untreated natural fiber material e.g. blue jeans, hearing protection, leather gloves, and safety glasses. For the purpose of resetting a circuit breaker, never wear a lab coat or pants made of a synthetic material (e.g., nylon) because in the event of an arc flash it not only will not protect you; it could melt on you and make an already bad situation worse.

For the resetting process you get one (1) try. If you are a qualified electrical worker (ESO or energized electrical worker training) and you have a reasonable certainty as to why the circuit breaker tripped, you may proceed as follows:

1. Turn off or disconnect the source of the fault or overload. Prepare for resetting the circuit breaker by putting on the minimum required PPE.
2. Standing off to the side of the panel, open the panel door and locate the tripped circuit breaker.
3. Make sure the circuit breaker is in its tripped state and not switched OFF. If you find the circuit breaker switched OFF, someone has positioned it that way. Either you have identified the wrong circuit breaker or someone else got to it ahead of you and you need to find out more information from your facility/maintenance coordinator. Until you know, you're done for the time being, so close the panel door and go get some answers or help
4. If tripped, switch the circuit breaker to the OFF position. Then, switch the circuit breaker to the ON position.
5. a. If the circuit breaker stays ON you're done. Close the panel door. You can now remove the PPE.

   b. If the circuit breaker trips again, there's more to the electrical fault situation than you initially realized. In any case, you're done. Close the panel door and remove the PPE. Last, but not least, contact your facility/maintenance coordinator for assistance.
6. Regardless of whether your attempt to reset a circuit breaker was successful, inform your facility/maintenance coordinator about the trip event. Repeated tripping of a circuit breaker causes wear that can lead to failure of the circuit breaker and that can be a serious situation.

For more information about the arc-flash hazard and resetting a circuit breaker, see P101-13, Section 6.4.4, "Arc-Flash Hazards," and Section 6.4.11, "Other Precautions for Personnel Activities, paragraph A, Operating Circuit Breakers or Fused Switches."